1

ZEISS-AEROTOPOGRAPH G. m. b. H.
JENA
P. O. BOX 117 · TELEPHONE 3541
CABLE ADDRESS: AEROTOPO

Recieved in Div 7.
Nov 24, 1939

Folding Mirror Stereoscope

with Removable Monocular Field Glasses and Tracing Stereometer

particularly suited for examining aerial photographs and for supplementing and producing small-scale maps of medium accuracy

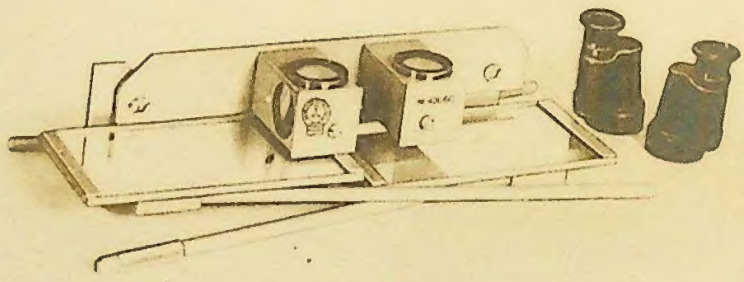

Fig. 1.
Folding Mirror Stereoscope, folded

The Folding Mirror Stereoscope is a simple and handy instrument intended for viewing stereoscopic pictures and designed to fold into a small space for convenience in storage and transportation. It is suitable for examining stereoscopic pictures of any kind, but is especially meant for aerial photographs of up to 7 · 7 in. or 7 · 9½ in. size. Larger pictures can be viewed a section at a time by shifting the stereoscope along over them. The pictures need not be taken with a stereoscopic camera, but may be taken successively from the ends of any base after the usual procedure in mapping by photogrammetry. In aerial photographs, an overlap of about 60 per cent is the rule for successive exposures, so that about 60 per cent of the total picture area can be viewed in relief.

The Folding Mirror Stereoscope takes the place of our previous "Aero-Photograph Stereoscope", over which it has the advantages of pronouncedly *low price and simple* and *light design*. The instrument serves not only for scanning stereoscopic pictures, but above all for *determining their real content*, and as a means of obtaining a truthful impression of the general features in aerial views and for the study and judgment of details. Such matters are very frequently not to be interpreted from a single photograph, and become clearly revealed only upon being viewed stereoscopically.

The instrument therefore constitutes an almost indispensable auxiliary for aerial survey and for the production of plans and maps from aerial photographs. Additional value is given the Folding Mirror Stereoscope by the *removable field glasses*. These give a four-fold magnification and thus allow the various portions of the picture to be subjected to still more exact scrutiny. Small details

zt. vdv. 80

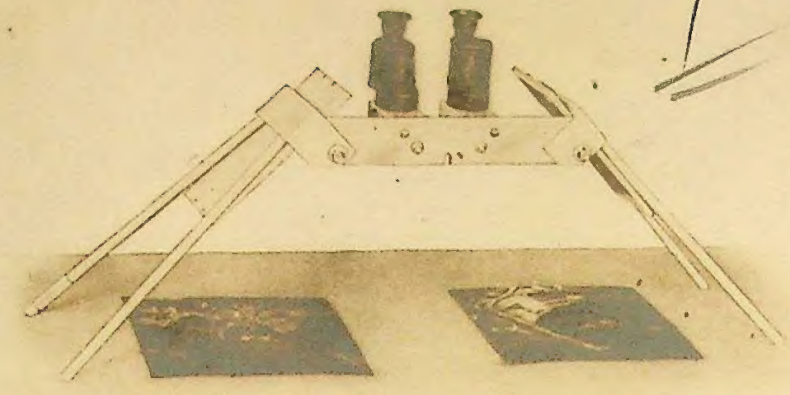

Fig. 2. Folding Mirror Stereoscope, with field glasses in position, ready for use

thus become readily discernible, and it is an easy matter to determine existing or prospective terrestrial control points suitable for utilizing the pictures in the composition of mosaics or maps. Because of the light weight of the instrument, its folding design, and the small space occupied by it when in use, it may be taken along *for work in the field*. This means a large advantage by the aid afforded field parties in obtaining usable plotting data and by the avoidance of needless measurements. Also in cases where aerial mosaics or the topography as ascertained from aerial photographs are to be complemented by elevation measurements taken on the ground, it is important to have a stereoscope suitable for field work.

A still larger field of use is opened to the Folding Mirror Stereoscope by the addition of the *tracing stereometer*. This is a parallax measuring instrument essentially composed of two glass disks each bearing a measuring mark, and of a tracing device. The two glass disks are connected by a micrometer screw in a manner to allow of varying the distance between the marks. The instrument is placed on the pair of stereoscopic pictures as in Fig. 3. By turning the

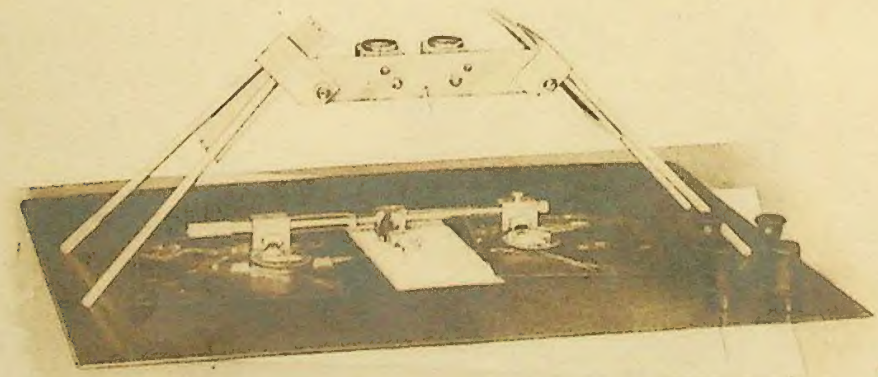

Fig. 3. Folding Mirror Stereoscope with tracing stereometer.

micrometer screw, the two measuring marks are fused to form a single spatial mark, which is brought into coincidence with identical image points by seating it on a point of the relief model. The different horizontal parallaxes resulting in viewing other identical ground points in the stereoscopic picture then correspond to differences in elevation of the ground. These differences are measured by successively re-seating the floating mark on the new ground points with the aid of the micrometer screw and reading the parallax values from the scale on the drum. The scale readings so obtained can be readily converted into the corresponding scale elevation values, either roughly from the approximate flying height and base length, and the camera focus*), or directly by comparison with the known

*) In approximate vertical exposures preferably by the formula $dh = \frac{h}{s} dp$, where h is the flying height in m, s the distance in mm, measured on the pictures between the points corresponding to the two principal points, and dp the measured parallax difference in mm.

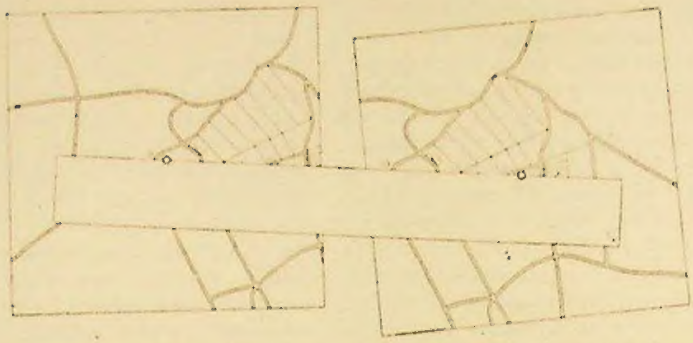

Fig. 4. Lining up approximately vertical photographs from epipolar rays

difference in elevation between two or more control points or "spot heights" in the picture pair. In this manner it becomes possible to measure with the tracing stereometer *relative differences in elevation* on the pictures, including differences in the elevation of the ground as well as the height of objects such as trees, houses, bridges, vehicles, and the like.

The tracing stereometer has provision for *shifting the zero point to* obtain a round value for the initial elevation and thereby to facilitate and speed up measurement.

If, when the spatial floating mark has been placed on a point of the ground relief model and without changing the micrometer setting, the stereometer is moved about so as to maintain a continual contact with the ground, then the floating mark describes a form line. When the pictures are exact vertical or rectified photographs, this curve will be a contour line. The approximate form lines derived from non-rectified approximately vertical photographs must be corrected by reference to spot heights to convert them into contour lines. By simultaneously following with the micrometer screw, the topography may also be tracked and traced. It is necessary, of course, to move the instrument over the pictures in such a way as to prevent vertical parallax between matching picture points and the measuring mark, a requirement which will be easily fulfilled after a very little practice.

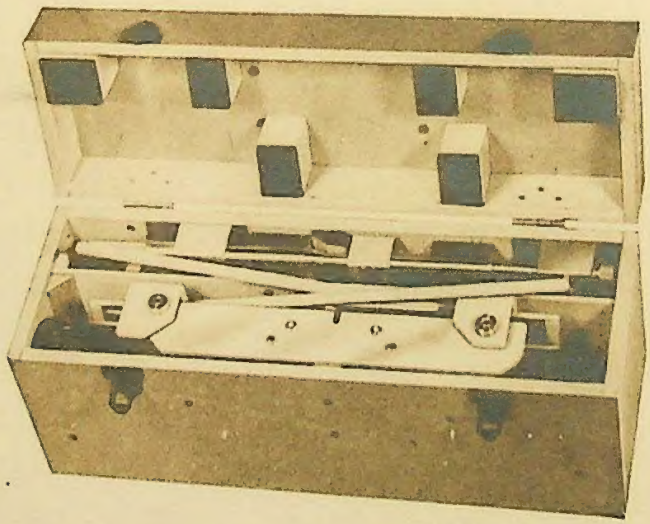

Fig. 5. Folding Mirror Stereoscope with field glasses and tracing stereometer, packed in case

In combination with the tracing stereometer, the Folding Mirror Stereoscope therefore can be applied, not only to viewing stereoscopic pictures and ascertaining their content, but also to measurement, and in the case of vertical photographs, to the *production of maps*. The accuracy of the maps generated in this way will depend, apart from the scale of the pictures, upon the selected map scale and the density of the existing control point network. This method is particularly well suited for *rapidly obtaining small-scale maps of moderate accuracy*, or in other words maps of little developed regions, and for rapidly filling in the gaps in existing but incomplete map records.

In complementing incomplete maps, it is preferable to use, not the original photos, but rectified photos either on a scale equal to that of the map or suitably enlarged, say to $1\frac{1}{2}$ or 2 times the map scale. From these photos, the gaps are filled with the aid of the stereometer.

The *manner of using the instrument* will be so clear from the pictures as hardly to require explanation. The stereoscope is folded out and set up on a plane table or drawing board over the pair of matching

stereoscopic pictures. A threaded foot sleeve on one of the four legs affords provision for securely setting the instrument. In placing the pictures, it is merely necessary to bear in mind that identical points on the background of the two photos must be at a distance of $10\frac{1}{2}$ inches from each other. This, at least, is necessary for viewing the pictures through the removable field glasses. Without these, the distance may be less, and in fact the beginner will as a rule be more easily able to obtain the spatial impression with a short distance. With oblique photographs, it may at times become necessary to draw the pictures farther apart in order to view the foreground.

To the end of obtaining the best possible spatial impression, it is advisable to align the pictures to each other by epipolar rays. With approximately vertical photographs, this is best effected by fastening each picture to the board by a pin pushed through the center, placing a ruler in contact with both pins, and then rotating the pictures until identical points on both are intersected by the edge of the ruler. This alignment is indispensable if the pictures are to be evaluated with the stereometer.

The ground form and topographic lines are traced on a sheet of paper fastened midway between the two pictures, or on a duplicate of the picture opposite to that end of the stereometer bearing the measuring screw. In the case of rectified pictures of flat ground, it is also possible to trace directly on the map. In this event, it is of advantage to proceed in the manner illustrated in Fig. 3. The pictures are mounted on a fairly stiff board or panel provided with a $4\frac{1}{2} \cdot 8$ in. hole in the center for exposing the map underneath. The panel with the pictures and the stereoscope on it can then be slid along as a whole and oriented on the map without damage to the map or the need of cutting it up. A suitable material for the panel is about $\frac{1}{32}$ to $\frac{5}{64}$ in. hard fibre board about $20 \cdot 27\frac{1}{2}$ in. square, to which the pictures are preferably attached by means of transparent adhesive tape. The Folding Mirror Stereoscope, together with the stereometer and field glasses, are accommodated in a *wooden case* furnished with the instrument.

Weights and Dimensions

	Weight lb.	Dimensions in.	Order No.		
Folding Mirror Stereoscope	2.00	12.8 · 6.3 · 2.6 folded	29 42	29 41	
Pair monocular field glasses	0.78	3 high	29 43		29 40
Tracing stereometer	1.77	14.6 · 3.6 · 1.1	29 44		
Case about	4.40	15.8 · 4.3 · 7.1	29 45		
Total weight	9.55				

Dec. 7

62